

Ocean INSTITUTE

Targeted conversion of agricultural land

Restoring coastal waters through reduced nitrogen loading from land

■ ANALYSIS





The Ocean Institute is an independent, non-profit think tank and member-based association based in Copenhagen, Denmark. It was established in 2021 on the initiative of the VELUX FOUNDATION.

The Ocean Institute leverages the best available knowledge to shed light on the state of the ocean and to support decision-makers in responding with the required urgency and effectiveness.

*Front page photo:
Coastal agricultural land, Denmark
Silvan Schuppisser*

KEY MESSAGES

Denmark is obligated to ensure good ecological status in its coastal waters by 2027. **The Green Tripartite Agreement** marks a major policy shift, introducing targeted land conversion as the central tool to reduce nutrient pollution.

This analysis finds that:

1. The conversion of agricultural land to nature and forests is concentrated in certain parts of Denmark creating **hot spots for major land use change**.
2. More than **470,000 hectares** of agricultural land may need to be converted to forests and nature to reduce nitrogen pollution to reach targets and restore good ecological status.
3. Converting agricultural land to forests and nature to reduce nitrogen pollution should be used as a tool to target areas with **highest nitrogen loss**. Local limits on nitrogen loading can effectively complement land conversion.

WHY LIMITING NITROGEN POLLUTION IS ESSENTIAL FOR DANISH COASTAL WATERS



Ecological status of Danish coastal waters

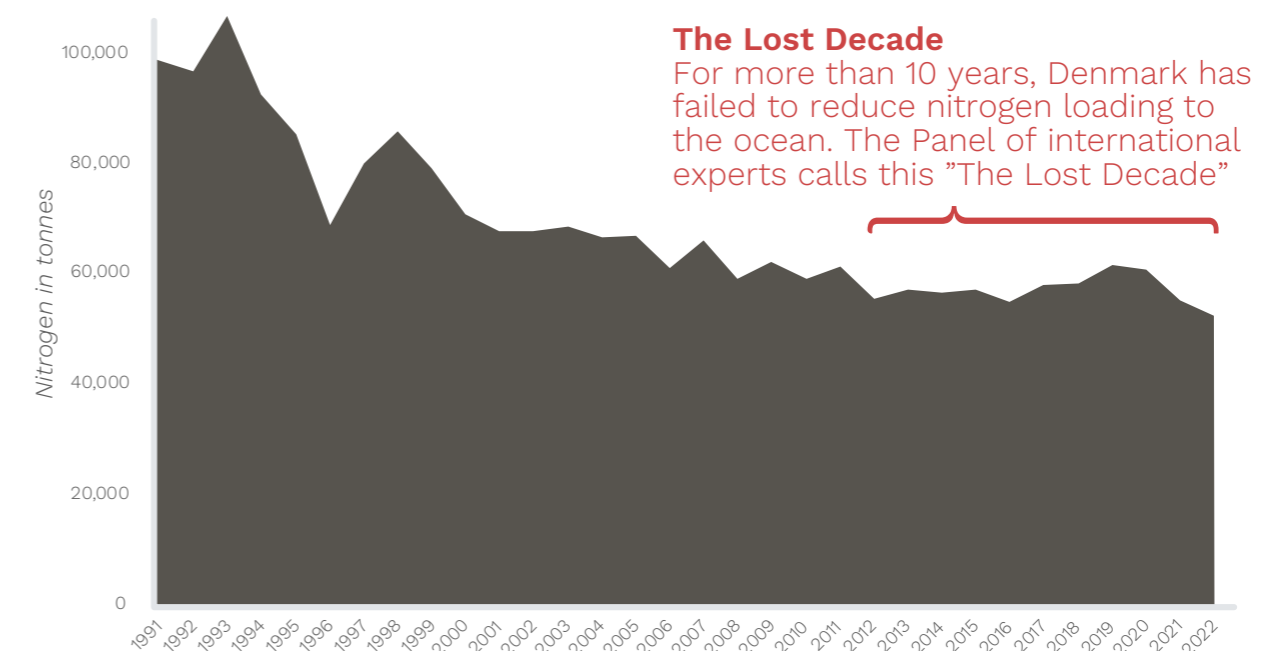
None of Denmark's 109 coastal waters are in good ecological condition, despite the EU Water Framework Directive requiring all water bodies to reach good status by 2027¹. One of the main causes is **nutrient pollution from agriculture**², particularly nitrogen loading from fertilisers leaching into surrounding coastal waters.

Denmark has the highest share of agricultural land area relative to total land area in the EU, a long coastline, low exchange rate of water in the inner Danish seas and a seasonally strong boundary layer in the water column, limiting oxygen transfer to deeper layers. These factors act as a damaging cocktail for the coastal waters in Denmark. The consequences are large annual algal blooms, widespread low oxygen conditions, fish die-offs and ultimately a significant degradation of the marine ecosystems.

HISTORIC REGULATION OF NUTRIENT POLLUTION IN DENMARK HAS BEEN INSUFFICIENT

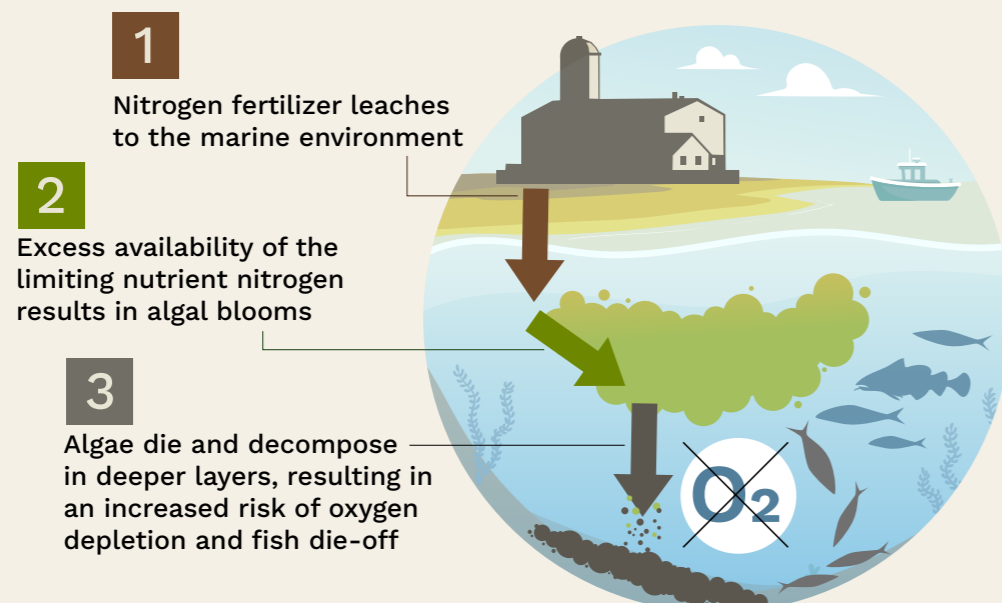
Since the early 2000s until today, there has only been a slight decrease in nitrogen loading to Danish seas. **Nitrogen loading has remained almost constant over the past 10 years.** At the same time, there has been **no improvement in the environmental state of Danish coastal waters.** In the mid-2010's regulations on use of fertilisers were relaxed and while compensatory initiatives were launched to reduce nitrogen pollution from agriculture, participation was largely voluntary.

Danish land-based nitrogen loading

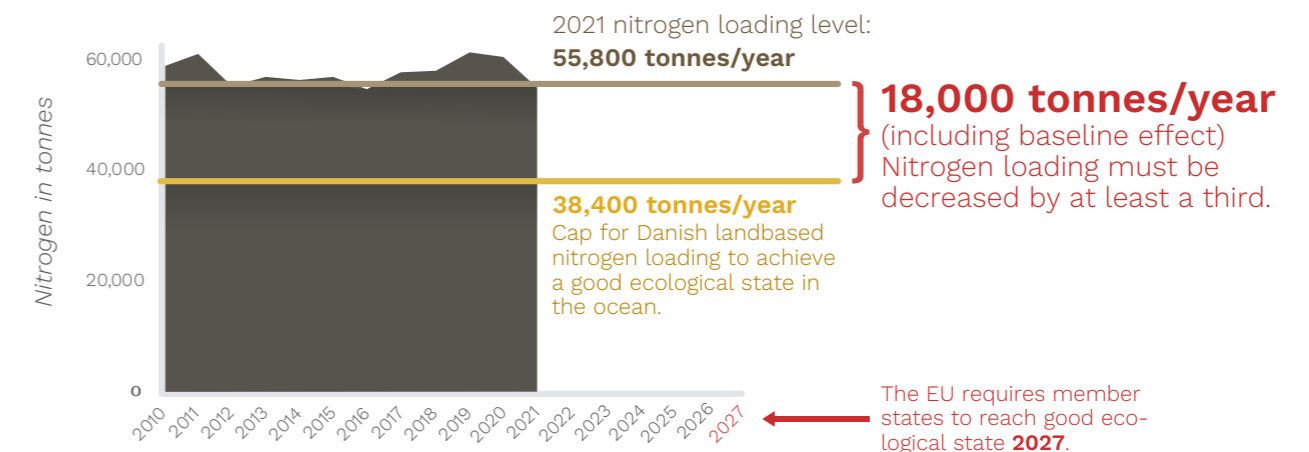


PRESSURES FROM NITROGEN POLLUTION

Nitrogen fertiliser from agricultural land-use leaches into streams and fjords, reaching coastal waters. Denmark's very high share of agricultural land relative to land area, short distances to fjords and coasts and low exchange rate of water amplify the problem. Excess nitrogen causes large algal blooms, and when algae die, bacterial degradation depletes oxygen near the seabed, which can lead to hypoxia events.



The Danish Ministry of the Environment assesses that in order to reach good ecological status in all Danish coastal waters over time, **nitrogen loading must be reduced to a national maximum of 38,300 tonnes per year** across the 109 coastal waters.





Wetlands, Funen, Denmark
Photo: Knud Erik Christensen

THE GREEN TRIPARTITE AGREEMENT

In November 2024, the Danish government reached a **political agreement** which established a new approach to reducing nutrient pollution and reaching good ecological status in all national coastal waters³.

The aim is to **restore coastal waters** through targeted conversion of **390,000 hectares** of farmland into wetlands, nature, and forest areas, **reducing nitrogen loading by 13,800 tonnes**.

The Green Tripartite Agreement entails a **targeted nationwide conversion of 390,000 hectares of agricultural land to forest and nature areas** to reach the reduction in nitrogen loading. To achieve this, each catchment area has their own locally differentiated nitrogen targets corresponding with their coastal area.

The responsibility to plan and execute this target conversion will be delegated to 23 local tripartites, anchored in the respective municipalities. The local tripartites must prepare a fully comprehensive plan for meeting the full local action requirements and deliver by the end of 2025.³

Who constitutes the Green Tripartite?

The three main actors behind the Green Tripartite Agreement are the Danish government, the Danish Society for Nature Conservation and the Danish Agriculture & Food Council.

The Ocean Institute and the Green Tripartite Agreement

The Green Tripartite agreement offers a new path forward in addressing decades of regulatory failure on nitrogen loading. The Ocean Institute supports the agreement's dual approach of voluntary agricultural land conversions combined with locally differentiated caps on nitrogen loading.

The Ocean Institute is working to support the implementation by mapping priority areas for local land use changes while also working to raise the ambition level of the targets to enable the recovery of Denmark's marine environment.



Clear winter waters, Djursland
Photo: Tim Dencker

THE OCEAN INSTITUTE ANALYSIS

This analysis supports the local tripartites in planning the targeted conversion of agricultural land, by presenting local maps for each catchment area, using a prioritisation of types of agricultural land areas to convert, to meet local nitrogen loading targets.

For each of the 108 coastal water catchments areas of Denmark's coastal waters, result maps have been prepared showing how the conversion of agricultural land could achieve the local nitrogen targets.

The results of the analysis serve as input for planning local actions, but the maps do not constitute a definitive list of which lands must be converted.

The local land conversion depends on the willingness of landowners to participate and requires an assessment of each individual project's suitability.

PRIORITY AREAS FOR LAND USE CHANGE

The results of the Ocean Institute is based on a model for identifying priority agricultural areas for targeted conversion to reach local nitrogen loading targets which uses the following prioritisation:

1. Carbon-rich low-lying soils

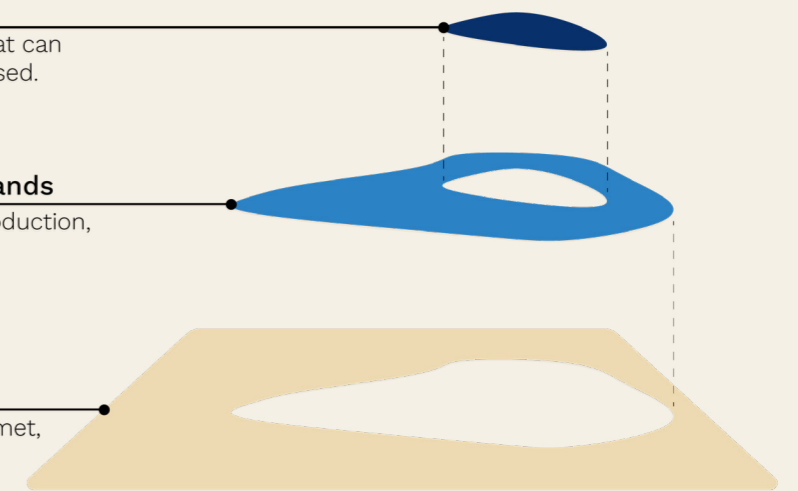
If additional effort is required, fields that can be converted into wetlands are prioritised.

2. Areas suitable for nitrogen wetlands

All peat soils are to be taken out of production, regardless of nitrogen reduction needs.

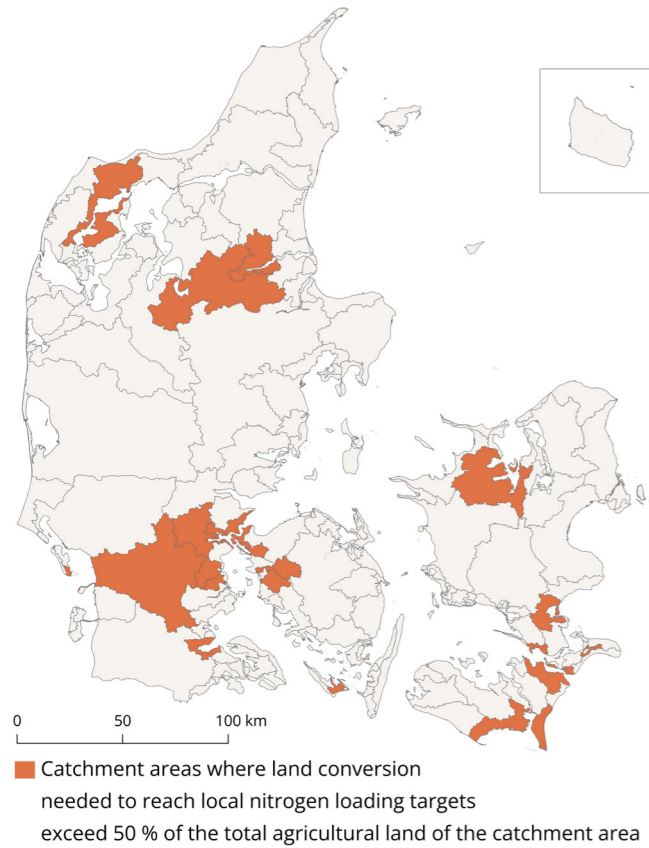
3. Other areas with low retention

If a nitrogen reduction target is still unmet, further fields with the lowest nitrogen retention are taken out of production.



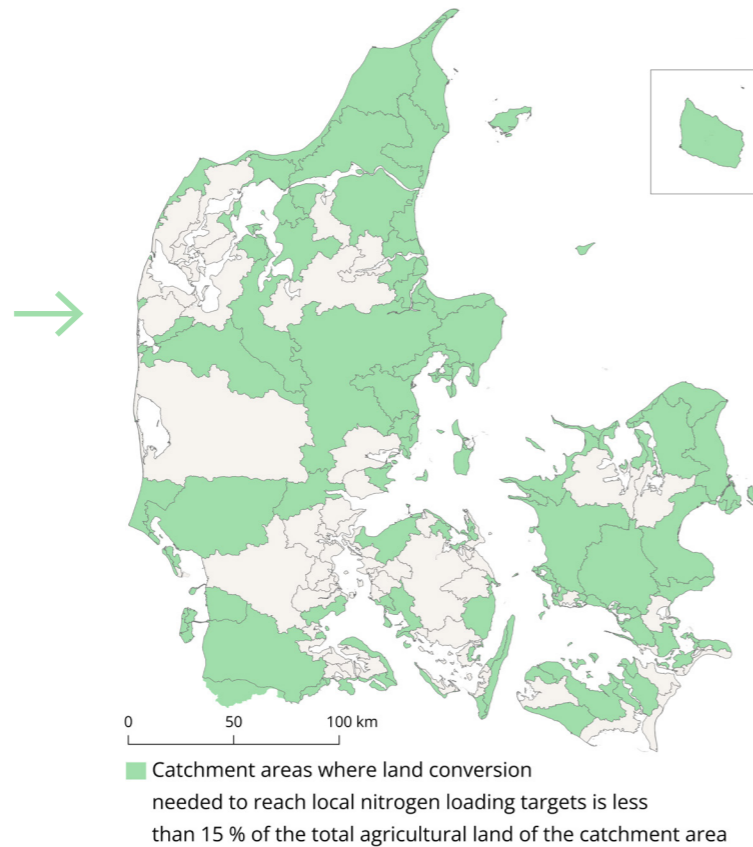
MAIN RESULTS FROM THE ANALYSIS

1. The conversion of agricultural land is concentrated in certain parts of Denmark creating hot spots for major land use change



← In certain catchment areas, the total land conversion needed to reach local nitrogen loading targets exceed 50 % of the total agricultural land of the catchment area. These catchments are all characterised by high local targets for nitrogen emissions relative to available agricultural land.

Conversely, more than half of all catchment areas require a conversion of less than 15% of the agricultural land.

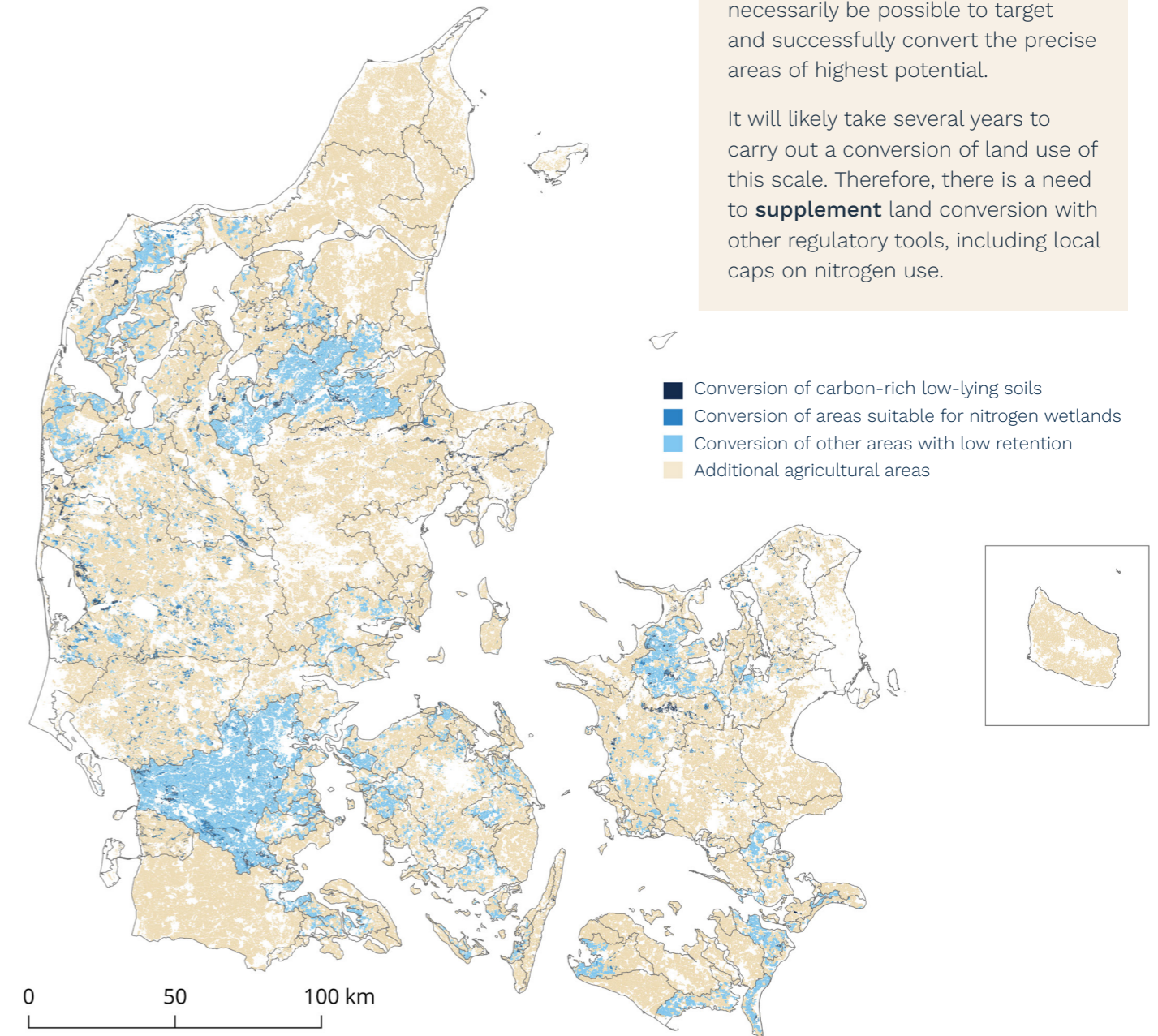


2. Targeted conversion of more than 470.000 ha. agricultural land is required to reach nitrogen loading targets

Reductions in nitrogen loading can be optimised by targeting agricultural land on **carbon-rich low-lying soils**, in other areas with the potential for the creation of **wetlands** and areas of **low levels of nitrogen retention**.

The analysis assumes that the most efficient areas can be converted. Even under this assumption, the estimated land area of 470.000 ha. exceeds the government's target of 390.000 ha. In practice, it will not necessarily be possible to target and successfully convert the precise areas of highest potential.

It will likely take several years to carry out a conversion of land use of this scale. Therefore, there is a need to **supplement** land conversion with other regulatory tools, including local caps on nitrogen use.



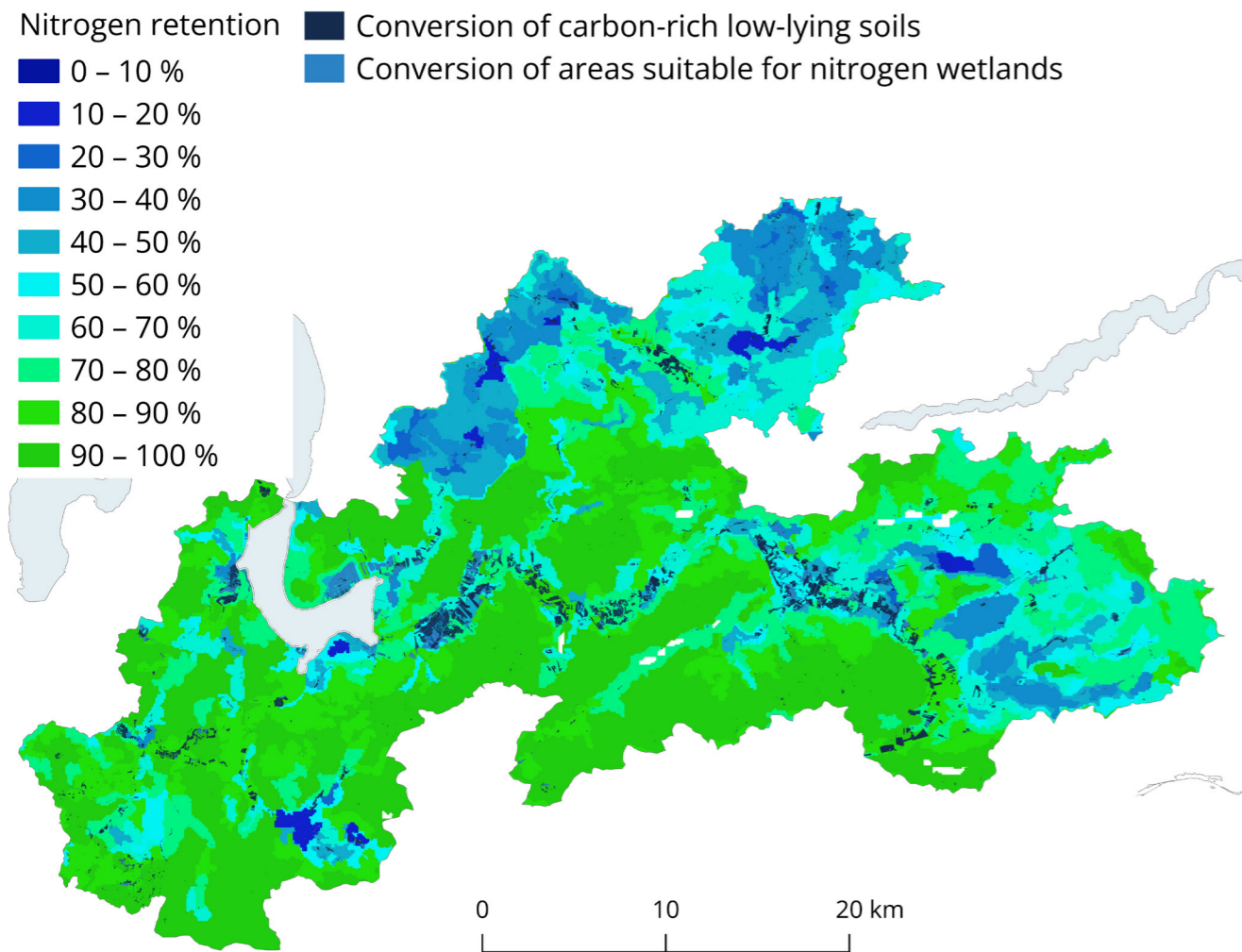
The results visualised as a map of Denmark's agricultural fields, highlighting which areas can contribute to achieving local nitrogen reduction targets. The shown areas have the potential to reduce nitrogen loading with approx. 13.000 tonnes nationally.

MAIN RESULTS FROM THE ANALYSIS

3. Marginal effect of land conversion decreases rapidly

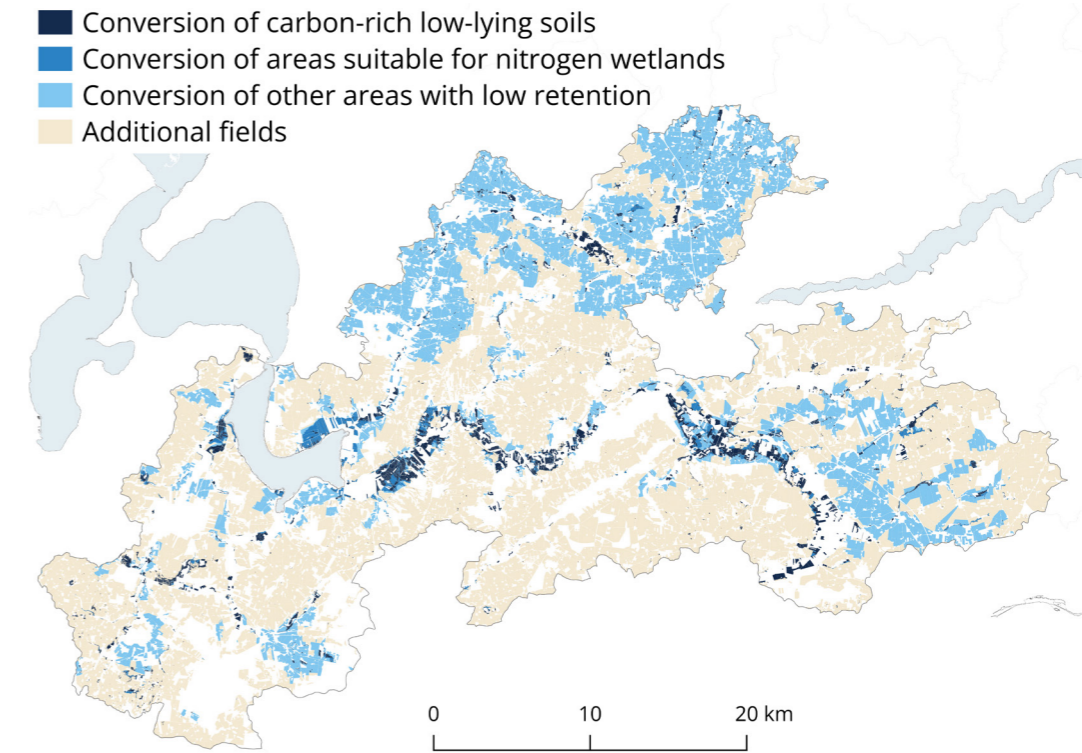
The applied method targets areas of **high nitrogen loss**. If the local target has not been reached once these areas have been converted into wetlands, forests or other nature areas, agricultural areas with a **much lower loss** are targeted. This implies that the first phase of targeted conversion of land will be much more effective than the second phase.

Example from Hjarbæk Fjord

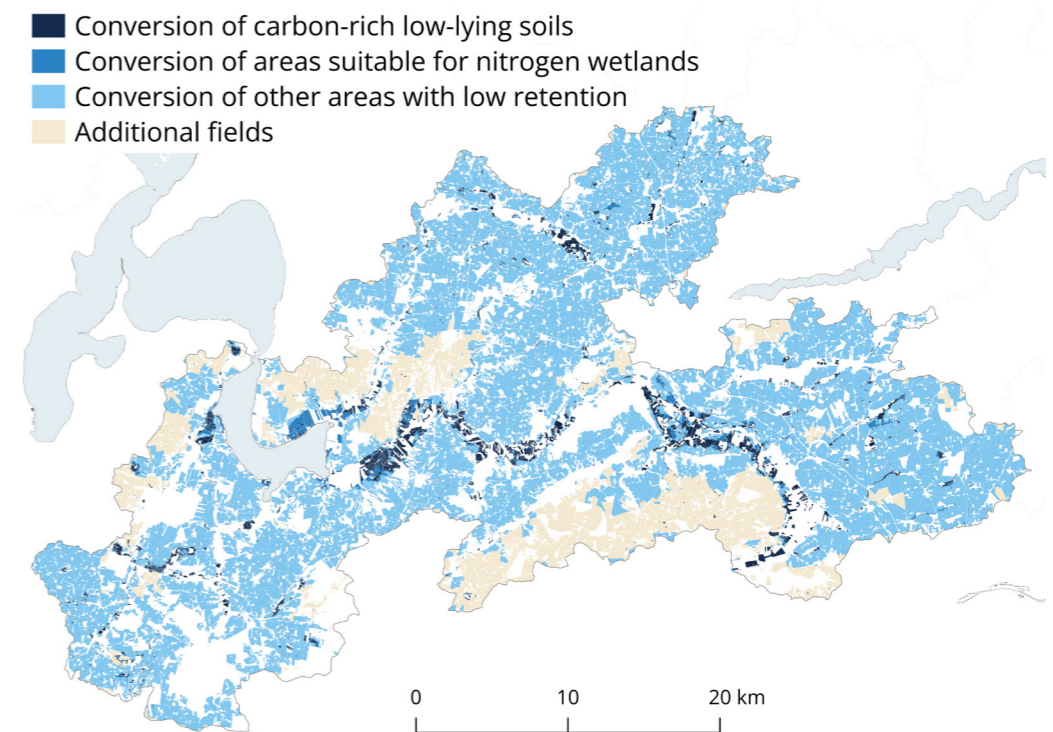


The first phase of targeted conversion of land will be much more effective than the second phase, illustrated by the following example from Hjarbæk Fjord, part of the Limfjord.

Phase 1: Highly effective reduction of nitrogen with a conversion of approx. 24.000 ha. Reduced loading is 680 tonnes, with an effect of 28 kg N per ha. converted



Phase 2: Reduced effectiveness of additional conversion covering approx. 36.000 ha. Reduced loading is 250 tonnes, with an effect of 6,9 kg N per ha. converted.



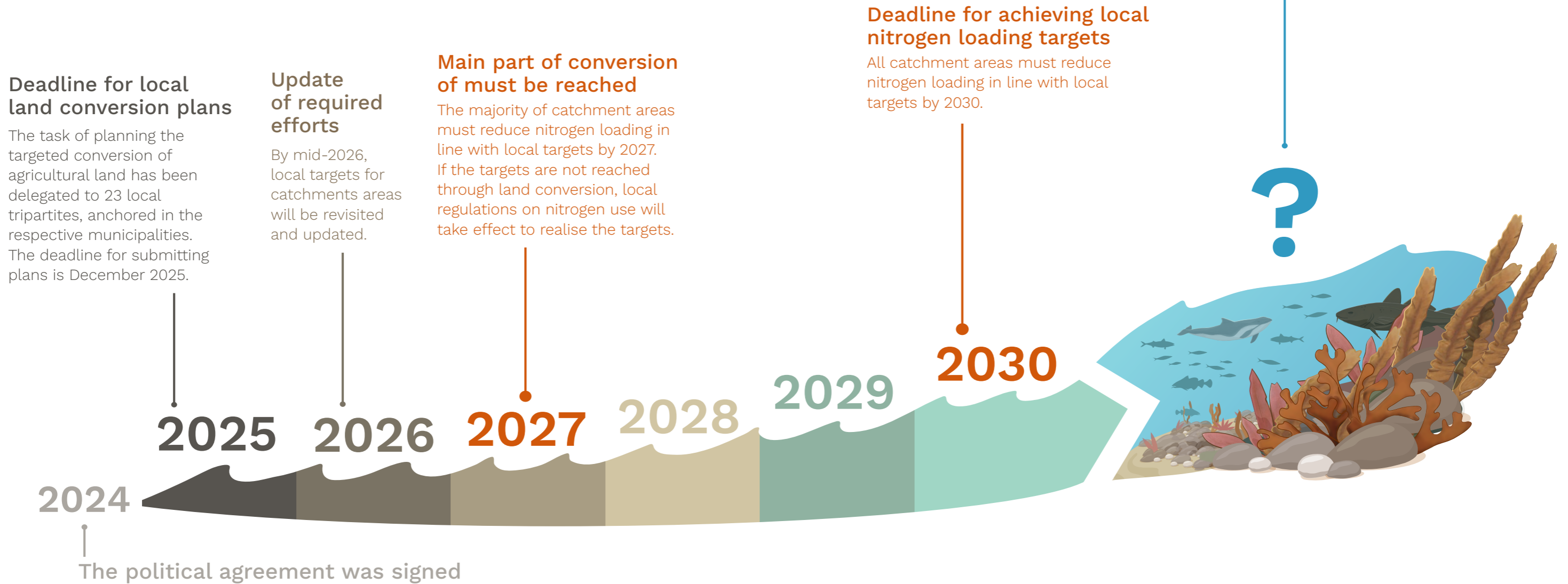
THE PATH FORWARD

From the beginning of 2026 municipalities will have plans for land conversion in all relevant catchment areas. There are three important milestones:

2025-2030: Conversion of agricultural land to forests and nature will continue facilitated by the 43 billion earmarked in the political agreement. Most catchment areas have a target of reducing leaching to target levels by 2027.

2027: The new model for regulating nitrogen takes effect entailing emissions-based rules on nitrogen use and farming practices which account for soil retention and crop type.

2030: Nitrogen discharge from all catchment areas should reach target levels. In principle, this will entail a level of nitrogen discharge compatible with regenerating good ecological status in Danish coastal waters over time.



REFERENCES

1. European Parliament. (2000). *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.*
2. Ministry of the Green Tripartite Agreement. (2024). *Draft of the revised the river basin management plans 2021 - 2027 (VP3).*
3. The Danish Government. (2024). *Agreement on the Implementation of a Green Denmark.*

Please cite as:

Ocean Institute. (2025). *Targeted conversion of agricultural land: Restoring coastal waters through reduced nitrogen loading from land.*

ISBN: 978-87-976716-1-0

Authors:

Tobias Krog Udsholt, Pernille Schou Jacobsen, Laura Richter Krarup

Graphic design:

Mads Lundgård

The Ocean Institute

Læderstræde 20, 1201 København K

CVR: 42479446

Phone: +45 4498 8000

info@taenketankenhav.dk

www.taenketankenhav.dk

Ocean INSTITUTE

Supported by VELUX FOUNDATIONS